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ABSTRACT

The Executive information System (EIS), a decision support system for the executive, is defined, a comparison is made between EIS and its predecessors, and the differences between EIS in academic institutions vis-a-vis private business firms are discussed. An outline is also provided of the technological and data requirements for executive information systems in higher education as well as a table that lists Executive Information/Support Systems, the companies that provide the systems, the area of business the systems are designed for, and the EIS product. Finally, examples of EIS as they are used within specific universities and colleges are described. Contains 5 references. (GLR)

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**What's New in Decision Support:
Executive Information Systems**

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Jean Endo
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What's New in Decision Support: Executive Information Systems

Abstract

An executive information system (EIS) is a decision support system for the executive. The executive as end user imposes new and special requirements on the system. Some of these requirements are technological, but it is the data requirements and design of the system to meet strategic planning needs that are of most interest to institutional researchers. This paper offers a definition of EIS, compares EIS with its predecessors, discusses what is different about EIS in academic institutions vis-a-vis private business firms, and outlines the technological and data requirements for executive information systems in higher education.

What's New in Decision Support: Executive Information Systems

A Definition of Executive Information Systems

An executive information system is a decision support system for the executive. Previous information systems for decision support required the executive's staff to play an intermediary role between the executive and the data. What distinguishes an EIS from its predecessors is that *the end user is the executive*. The design and technology of an EIS must match the computer skills of the executive and deliver the desired information directly to the executive's desktop.

For the purposes of this paper, a formal definition of an executive information system is *an interactive computer-based system that allows executive officers to access data and information that can be used to identify problems, explore solutions, and guide the strategic planning process*. The purpose of an executive information system is to deliver data to the executive's workstation and transform it into information that conveys useful knowledge to the executive. This information is used to investigate solutions for pressing managerial problems and to make planning decisions for the institution.

The current high level of interest in executive information systems comes from the recognition that the best decision support system is one that meets the needs of senior managers. Information systems for decision support have moved from a data processing environment to the direct utilization of data for executive support. In many respects EIS is the logical conclusion of information system development because an EIS is information processing for executive decision support.

Information Technology for EIS

The executive as end user imposes several new requirements on the technology. These requirements help define the characteristics of an executive information system.

- An EIS must be "executive-friendly," matching the computer skills of this type of user. For example, an EIS that depends entirely on use of the keyboard will not be used by most executives. A menu mode with windows, pull-down menus, and a mouse or touch-sensitive

screen should be available. A command mode also should be included for computer-savvy users. An EIS also must be very forgiving. It should allow an executive to undo a procedure or backtrack to previous screens, and the system should never lock up the keyboard. On-line, context-sensitive help is also required.

- The system must meet the needs of the executive in terms of speed. Time is a critical resource for the executive and any system that takes longer than a few seconds to change screens, compile data, or present a graphic will not be acceptable. If a complex operation is required (e.g., obtain data from a mainframe data base), an EIS should give the executive the option of performing the task in background while he/she moves on to other tasks.
- Executive information systems must be graphic-oriented--able to deliver a variety of graphical displays. An EIS user will not only want to see the numbers, but also how the numbers look in a bar graph, pie chart, or line plot. This enhances the executive's ability to spot trends and discrepancies, and to communicate his/her findings to colleagues, subordinates, or external audiences. The benefits of graphic displays over numerical tables are well-known. An EIS exploits these advantages to give the executive a better understanding of the data and a readily-available presentation tool.
- Increasingly, executive information systems are primarily based on desktop computer technology. The first generation of EIS software packages were, for the most part, based on the mainframe or minicomputer. The emerging platform for executive information systems is the desktop workstation. Specifically, the information processing functions of the EIS are well suited to the executive's desktop computer, with mainframe computer usage restricted to transaction processing and data storage--the areas where mainframe processing capability and storage capacity is required. This conserves mainframe resources and assigns the personalized tasks of data manipulation, analysis, graphics, and communications to the desktop computer. This system of distributed data bases and cooperative processing among multiple levels of computers allows applications to be placed on the platform that is best suited for the task.

These requirements severely strain the limits of current information technology. As a result, the EIS failure rate is high and relatively few executives use an EIS. However, as information technology advances beyond the personal computer to the workstation environment, executive information systems will become more feasible and more numerous.

Data Requirements for EIS

The information system requirements of an EIS also are considerable. In addition to providing the executive with basic institutional data (e.g., as in an electronic factbook), the information system should include these capabilities:

- Integration of data from different data bases--student, financial, and personnel--is necessary to allow executives to view and analyze related data from separate data bases (e.g., student/faculty ratios, research expenditures per faculty FTE).
- Inevitably the executive will want to "drill down" (i.e., view detailed data that comprise summarized data). For example, a president may want to see expenditure data by department after viewing college-level data. Drilling down allows the executive to discover exceptions or anomalies.
- Executives are usually more interested in seeing trends rather than one year in isolation. Historical data reveal trends and helps the executive to place current year data in context. As a result, historical data should be available to allow year-by-year comparisons.
- Information is always more meaningful if viewed in comparison to a peer group of institutions. This means the EIS should be able to access external data that are comparable to institutional data in the original data set.
- Information for executive use must be delivered in a form that is determined by the critical success factors of the executive. Critical success factors have been defined as "those few key variables about which reliable data are absolutely necessary to make wise strategic choices and to assess progress toward goals" (Cope, 1986, p. 70). In the higher education environment some critical success factors are universal (e.g., enrollment indicators, qualitative measures),

but other factors will depend on the institution's strategic mission (e.g., peer group comparisons, economic development data) and the needs of the individual executive (e.g., financial ratios, service measures). The search for useful information is inherently a personalized task because information needs will depend on the executive and the particular decision to be addressed. Identifying and meeting the specific information needs of the executive is critical for successful implementation.

These requirements make an executive information systems what a decision support system was always supposed to be--a decision support system to be used *directly* by the decision-maker.

EIS in an Executive *Support* System

There is yet another attribute of executive information systems, one that draws the biggest distinction of all from previous information systems. An EIS does not stand alone--it functions as the central, core portion of an executive *support* system. There is considerable confusion about EIS versus ESS. Many magazine articles use these terms interchangeably and most authors fail to define them clearly. In this paper an executive support system is defined as three separate, but overlapping, components. These three parts roughly follow Rockart and DeLong's (1988) description of the "managerial purposes" of an ESS.

-- Mental modeling: This process begins with designing the EIS. The executive user is asked to identify critical success factors--data, ratios, and other information the executive needs to monitor the performance of the college or university. As the EIS is prototyped, the executive builds mental models of the institution and these models are identified and integrated into the EIS. Eventually a circular process is established: the executive's perspective of the institutional environment is enhanced by the EIS, the mental model is altered, the EIS is readjusted, and the process starts over again.

To illustrate how an EIS can assist in constructing mental models consider an executive who wants to compare impressions from the global environment with institutional conditions. Executives are bombarded with studies, anecdotes, and newspaper articles about current issues

in higher education. From these sources executives tend to form a mental image of the higher education environment. An EIS allows the executive to test these impressions to determine if they apply to his/her institution. For example, one issue of continuing concern to institutional managers is the tenure ratio of the faculty. As a large number of faculty retire in the next few years awareness of tenure ratios will be critical in addressing faculty replacement issues. With an executive information system, an academic vice president can seek answers to questions such as what is the university's tenure ratio, what are the differences in the ratio by department, and how does the institution's tenure ratio compare with tenure ratios at peer institutions. After this initial investigation, the vice president may ask additional questions, perhaps of a more predictive nature (e.g., what will happen to the tenure ratio if the institution continues awarding tenure at current rates, what is the distribution of tenured faculty by age). This can lead to changes in the EIS and better information for enhancing the executive's mental model. Still more questions may arise, increasingly of a more strategic nature (e.g., what would be the impact of an early retirement plan).

The use of an EIS for mental modeling can be especially useful for managers new to an institution. Reviewing the library of tables and graphics used by the executive's predecessor informs the new person of planning activities of his/her predecessor and helps the new executive to build a mental model of the institution.

- Executive information system: The EIS is the people, technology, policies, and documentation that deliver data to the executive and transform it into information.
- Executive office automation support: Access to timely and accurate data is only one consideration in the executive decision-making process. Consultation with colleagues, identification of decision choices, and a thorough discussion of options typically precede the decision. After making a decision, the executive needs to be able to communicate that decision and follow-up on it later. Office automation support consists of tools to support these aspects of executive decision support. For example, electronic mail and computer

conferencing facilitate communication with colleagues; tickler files and schedulers can be used to follow-up on decisions and manage office communications. The manager who is more computer savvy may need additional tools such as personal information managers, outliners, and statistical packages.

Information Systems for Decision Support

Executive support systems represent an evolutionary, rather than revolutionary, advancement of information systems for decision support. Table 1 on the following page compares executive support systems with previous generations of similar information systems: electronic data processing, management information systems, and decision support systems. Note that Table 1 uses executive support systems as defined in the previous section (i.e., mental modeling, EIS, and office automation).

[insert Table 1 about here]

Executive Information Systems in Business

As was the case with previous generations of administrative information systems, the implementation and use of executive information systems began in the private business sector; only recently have institutions of higher education begun to incorporate information system technology from the business sector into the university administrative environment. This section gives a brief overview of EIS in the private business sector, with special emphasis on software used by service and industrial firms.

EIS/ESS Use in Business

Although no comprehensive survey of EIS/ESS¹ use in business is available, it appears that the principal use of EIS in this sector is for operational and/or control decisions. Interestingly,

¹Executive Information System and Executive Support System are used interchangeably by vendors to describe this type of software. There are distinctions in this software—some packages provide just information processing, others furnish the user with more, including executive support such as electronic mail. In this section, all such software are classified together as EIS/ESS software.

Table 1
Comparisor of Information Systems for Decision Support

	<u>Electronic Data Processing</u>	<u>Management Information Systems</u>	<u>Decision Support Systems</u>	<u>Executive Support Systems</u>
FOCUS	data	information	information for decision support	comprehensive decision support
GOAL	efficient transaction processing	structured information flows	decision support	decision support on the executive's desktop
OUTPUT	database	report generation	models, data links, follow-up tools	information and graphics to assess critical success factors
USER INTERFACE	summary report	inquiry and report	interactive, data oriented	interactive, graphic oriented
HARDWARE	mainframe computers	mainframe computers	mainframes and microcomputers	principally executive workstations
SOFT-WARE	batch processing	database	spreadsheets, statistical packages, graphics	graphics, e-mail, personal information managers, schedulers,

much of the management literature in this area focuses on the fragmented character of executive work, especially the unstructured nature of decisions that occur at this level. However, product demonstrations, software literature, and anecdotes of EIS applications (e.g., Rockart and DeLong, 1988) place far more emphasis on the use of information for management control decisions, rather than strategic planning or similar applications. It is far more likely that an EIS will be used to access sales data, a balance sheet, or stock market prices, rather than environmental scanning data, predictive models, or similar information for strategic planning.

Because the primary use of EIS/ESS in business is for management control, the basic data for EIS are financial data. Again, software demonstrations, product literature and anecdotes in the EIS literature emphasize that most executive information systems are used primarily for access to and analysis of financial data (e.g., see Chapter Five of Rockart and DeLong).

Table 2 lists some of the firms that have implemented an EIS or ESS. This table lists the company, the company's area of business, and the EIS/ESS software in use, if known. Table 2 was developed from a review of product literature and periodical articles; this table is not a comprehensive list of business firms and government agencies with executive support or executive information systems.

[insert Table 2 about here]

Although no one type of company dominates the list of companies using an executive support system, financial institutions such as banks and insurance companies have been primary targets for EIS development.

EIS/ESS Software

The implementation of EIS/ESS differs from company to company. Some systems use the personal computer for information processing and analysis, other systems rely almost exclusively on minicomputers or mainframe computers. Some companies are using comprehensive, predefined systems (e.g., Pilot or Comshare), others have implemented EIS/ESS with software tools (e.g., Execucom's IFPS/Plus), and other companies have developed their own system, using

Table 2
Executive Information/Support Systems

<u>Company</u>	<u>Area of Business</u>	<u>EIS Product</u>
Arizona Dept of Transportation	government	Pilot
Avon Products	cosmetics	Pilot
Bank of Boston	financial	Pilot
Banco Internacional de Columbia	financial	
Beneficial Corporation	financial	
Boeing Company	aerospace	Pilot
Citizens and Southern	financial	Comshare
Combustion Engineering	power plant equipment	
ConAgra	agricultural products	
Conoco	petroleum	internal
DuPont	chemicals	internal (Lotus)
Duracell	batteries	Comshare
Electric Power Research Institute	consulting	Pilot
Firestone	tires & rubber	internal
First National Bank of Chicago	financial	
General Electric	consumer goods	Comshare
General Telephone & Electric	utility	internal (Hypercard)
Gillette Company	consumer goods	Pilot
Grumman Data Systems	data processing	Comshare
International Computers Ltd.	information technology	
John Hancock	insurance	Comshare
Johnson and Johnson	consumer goods	internal
Kodak	photography	internal
Kraft	food products	Comshare
Lincoln National Corporation	insurance	
Marine Midland	financial	Pilot
Metropolitan Life	insurance	Comshare
Monsanto	consumer goods	Pilot
Motorola	appliances	Comshare
New England Mutual Life	insurance	Comshare
Oscar Mayer	food products	Comshare
Phillips Petroleum Company	petroleum	internal
Public Service Electric & Gas of New Jersey	utility	Pilot
Raytheon Corporation	missile systems	
Unisys	conglomerate	internal
Unum Life Insurance	insurance	Pilot
U.S. Commerce Department	government	(purchased product)
U.S. Government Printing Office	government	internal
Westinghouse	conglomerate	Pilot
Whirlpool	consumer appliances	Comshare
Xerox Corporation	office products	internal

internally developed information system software. Almost all EIS/ESS products emphasize graphic display of available information. Most products also include a communications module, usually electronic mail, and access to on-line business news services such as the Dow Jones News/Retrieval service.

The development of EIS/ESS software will be more important for the advancement of EIS than advances in hardware. The executive environment is a demanding one for software developers and much remains to be done. Integrated software that operates on a variety of platforms (e.g., IBM's OfficeVision) and the development of a common graphic unit interface (e.g., Presentation Manager) are two examples of emerging software technology that will encourage further EIS development.

Executive Information Systems in Higher Education

Few observers of computing in higher education anticipated the advancement of desktop computing from almost nonexistence in the late 1970's to the ubiquitous use of personal computers in classrooms, laboratories, and administrative offices today. This increase in microcomputer use can be attributed to more powerful desktop computers, the multiplication of new applications, and the integration of various systems--micros, minis and mainframes (Green, 1988). More subtly, generous discounts and donations by hardware and software vendors to institutions of higher learning have encouraged the placement of computers on virtually every administrative desktop.

There is no reason to believe that the growth of personal computers will not continue, for the same reasons that have fueled this growth. Especially, as desktop computers become more powerful as the interconnectivity of systems (e.g., micro and mainframe) increases, the number of administrative personnel who use computers in their jobs will continue to grow.

Examples of Executive Information Systems

While most colleges and universities have not yet begun development of an executive information system, some institutions have initiated the development process. As emphasized

earlier, a definition of what composes an EIS is difficult. Thus what one institution labels as an "electronic factbook" may be considered an EIS at another institution. This list of executive information systems is not a comprehensive list, but rather illustrative examples of EIS applications at higher education institutions.

University of Hartford: A medium-size (8,300 headcount enrollment), private, comprehensive university with a strong background in decision support is implementing a Lotus-based EIS through the Institutional Research and Planning Office. The system currently is used for DSS-oriented activities of a predictive nature (e.g., enrollment planning, financial models).

Williams College: A small private college in Massachusetts, Williams is using FOCUS (a data base management system with a fourth generation language) to give senior administrative officers and middle managers access to on-line financial records. The system includes the ability to drill down to the departmental account level. At this time the system includes only on-line financial data with limited graphics capability.

Alamo Community College: A public community college enrolling 32,000 students on three campuses, ACC chose to implement an integrated mainframe-based system for access to frozen-file extracts from the administrative data bases. As at Williams College, FOCUS is the primary software tool for extracting data and producing reports. Unlike Williams College, frozen files are used and the system uses data from several administrative data bases (i.e., financial, human resources, students). For more information see Burmeister (1989).

Maricopa County Community College District: A nine campus system in Phoenix, Arizona, the MCCC District is developing an executive information system using FOCUS. The system is designed to be an analytical data base--a layer of summarized data from the transaction systems that offers more than the high-level summary typically offered by a factbook. More information about the Maricopa implementation can be found in Leslie, Pociask, and Alexander (1989).

EIS Applications in Higher Education

What is the future of executive information systems in higher education? How important will EIS be to institutional executives, and what purposes will EIS serve? Certainly the development of EIS in higher education will be different than that for the business sector. Higher education institutions are not profit-oriented enterprises and the financial management and control decisions typical of EIS implementation in the business sector will not be found in higher education. It seems likely that colleges and universities will place more emphasis on the use of executive information systems for strategic planning applications such as enrollment management, program development, and resource allocation, rather than financial control decisions.

Conclusion

In view of the potential offered to higher education institutions by executive information systems, can one expect the use of EIS to become widespread in higher education? If experience with other information systems is any guide, the answer to this question is "probably not." It is likely that EIS development will occur slowly and will differ markedly from institution to institution. American colleges and universities usually have been on the "lagging edge" of information system development. Although the theoretical frameworks and organizational strategies for new information systems have been developed in university business schools, introduction and development of these systems has occurred in the private business sector. The development of EIS probably will parallel the sporadic development that has characterized DSS development. That is, the managerial environment, computer systems, and institutional culture have encouraged DSS development in some institutions while others--probably a majority--have failed to implement any type of comprehensive DSS. So it likely will be with executive information systems; in institutions where the conditions are favorable and there is a strong background of using data for decision support, EIS development will flourish. In other

institutions, EIS development will not occur. In the end no single conclusion can be made about the future of EIS in higher education, it will be a different path for each institution.

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